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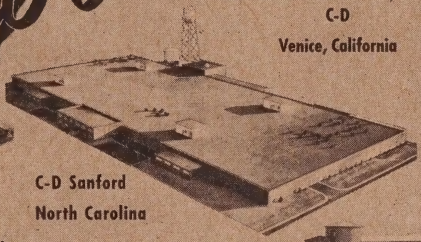

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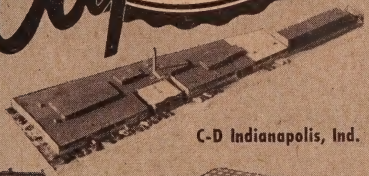

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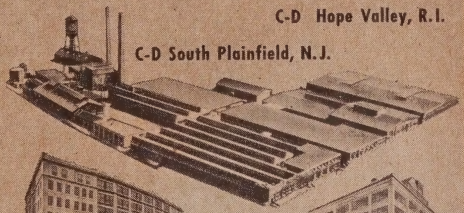

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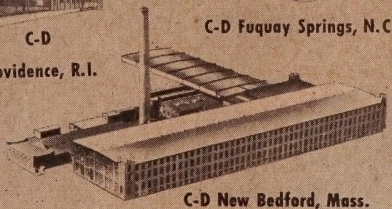

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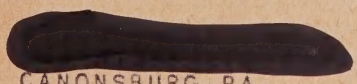

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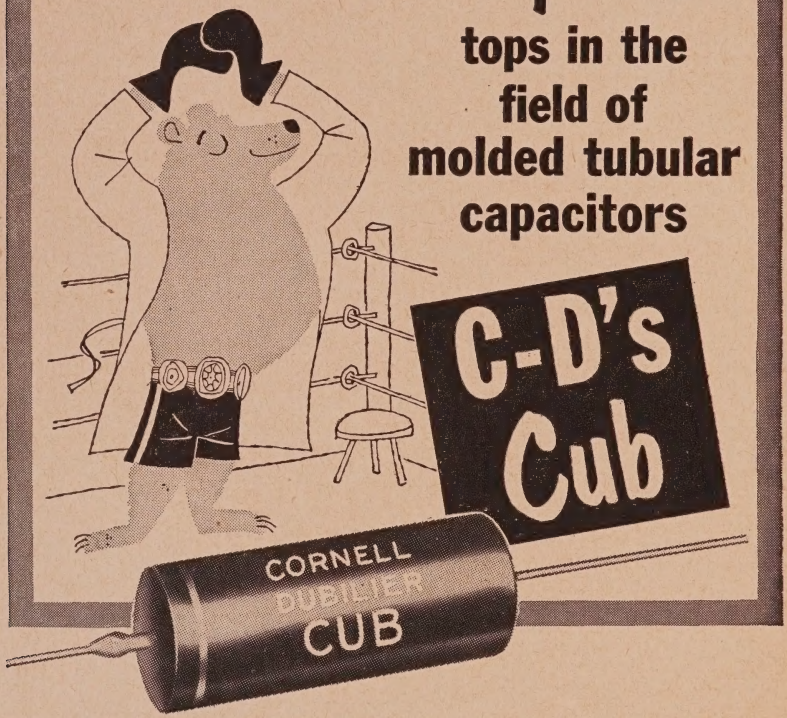

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INCREMENTAL INDUCTANCE MEASUREMENTS

Iron-cored inductors in electronic circuits frequently are required to conduct both alternating and direct components of current simultaneously. Typical examples are filter chokes in d-c power supplies, the primary windings of transformers in tube plate circuits, and audio coupling chokes in plate circuits. Figure 1 illustrates the usual condition in which the a-c component is small with respect to the d-c component. A steady value of current, the d-c component (I_2) flows through the coil, and upon this is superimposed the a-c component which oscillates about I_2 as a mean value, rising to the peak value of I_3 and falling to the trough value of I_1. The resultant current is seen to be a fluctuating dc, since all of the variations are confined to the region above the zero axis.

Presence of the d-c component modifies the inductance of the coil to an extent dependent upon core and coil size and core material. This is due to the characteristic shape of the magnetization curve of the core material and the shifting of the cycle of magnetization due to the a-c component to various points along the curvature by the d-c component. The permeability which the core material offers to this alternating magnetizing force superimposed upon a d-c magnetizing force is termed **incremental permeability,** and the inductance, the **incremental inductance.**

The inductance decreases as current increases. At low d-c levels, the effect is most pronounced (that is, greatest separation exists between incremental and zero-dc inductance values) in miniature transformers and coupling chokes in which the cores consist of small stacks of magnetic alloy laminations. An illustrative example is a commercial miniature coupling choke (U. T. C. Type 0-13) with an inductance of 300 henries at zero dc which drops to 50 henries at 3 milliamperes dc.

A practical problem arises in the testing of filter chokes. Obviously, the inductance of a choke measured in the complete absence of dc, as in a standard bridge test, will differ from the value at rated dc. This brings to attention the requirement that the inductance of all cored coils should be measured with rated direct current flowing through them. That is, only incremental inductance should be checked unless the coil manufacturer specifies the zero-dc inductance as the rated value, an infrequent practice.

Methods of Measurement

The measurement of incremental inductance, like that of most other electrical characteristics, is possible in a variety of ways. The method chosen in a particular case depends upon such factors as which instruments are available, acquaintance with the selected measuring circuit, and intended permanence of the test setup. Several typical methods are described in the following sections.

Conventional AC Bridge. The first system usually suggesting itself is the use of a standard a-c bridge (inductance or LCR type) with some provision made to pass a direct current through the coil under test. This method often is employed in labora-

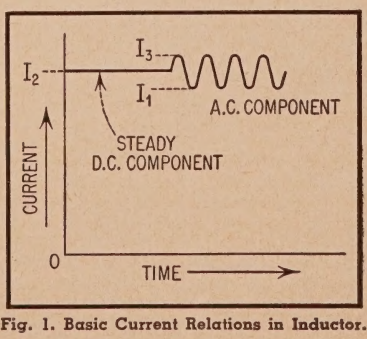

Fig. 1. Basic Current Relations in Inductor.

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tories and shops where incremental inductance is measured only occasionally and no need exists for a separate instrument or a permanent setup.

Passage of a direct current through the coil while it is in the bridge circuit is an operation not always easily accomplished with conventional bridges, since this must be done without degrading the bridge performance in any way or damaging any of its components. Moreover, provision usually must be made to segregate the d-c supply from the bridge signal voltage, and similarly in some cases to isolate the bridge circuit from the direct current. It is clear that a simple 4-arm bridge with a standard inductance in one arm could not be used, since the d-c component would flow through the standard, as well as the coil under test, and therefore alter its inductance value.

Most inductance bridges (and impedance bridges when switched to their L function) compare the unknown inductance with a known capacitance. The latter forms one arm of the bridge. The bridge circuit is either Maxwell or Hay. Figure 2 shows a basic Maxwell bridge with additional connections to a d-c supply.

The test coil is L_x and its internal resistance R_x. This forms one arm of the bridge. The other bridge arms are R_1 - C_1, R_2, and R_3. Rheostat R_2 is adjusted for inductance null, and R_1 for resistance null. At null, $L_x = R_2R_3C_1$ and $R_x = (R_3/R_1)/R_2$. Direct current is forced through coil L_x from an appropriate d-c supply and its magnitude is indicated by the d-c ammeter or milliammeter, M. Choke coil L_s, which must have a high impedance at the bridge signal frequency, is required to keep the bridge signal energy out of the d-c supply and to prevent the power supply circuit from upsetting the bridge balance. It must be able to conduct the d-c test current without saturating.

Capacitors C_2 and C_3 keep the d-c component out of the signal source and null detector, respectively, but it is evident from Figure 2 that dc can flow through the series combination R_1-R_2-R_3. Not only must these resistors be able to carry this current safely, but the deflection of meter M includes this bridge current as well as the coil current and must be corrected. Meter M may be placed in the lower right bridge arm where it will indicate only the current through L_x, however

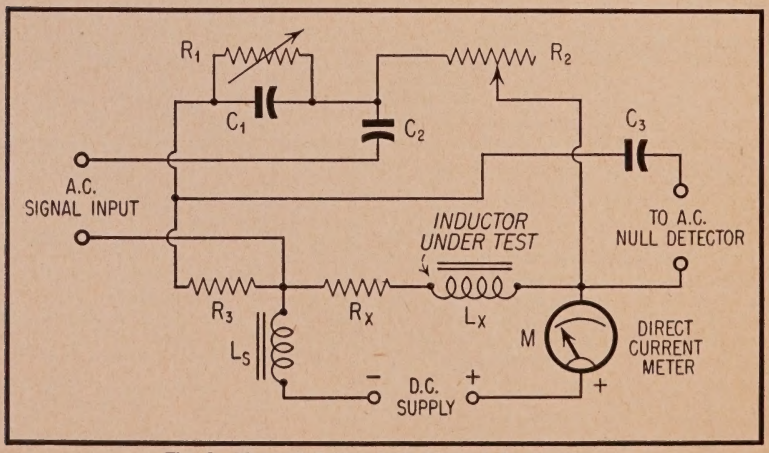

Fig. 2. Maxwell Bridge with Limited Application.

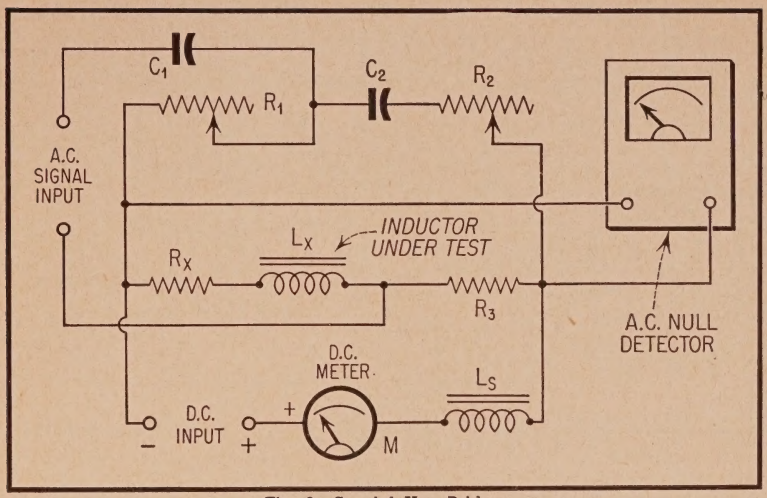

Fig. 3. Special Hay Bridge.

this is permissible only when L_x is known to be very large with respect to the inductance of the meter. This will be true in virtually every case except that of small pulse transformer inductance values.

Special Hay Bridge. Figure 3 shows the circuit of a Hay bridge intended as a permanent or semi-permanent instrument for incremental inductance measurements. In this arrangement, direct current can pass through only one bridge arm (R_3) except the arm containing the unknown inductance, L_x, and its internal resistance, R_x. DC is blocked from the other arms by the bridge standard capacitor, C_2. Resistor R_3 accordingly must be proportioned to handle the current safely.

As in the preceding example, choke L_s is needed for isolation of the d-c supply and must have a high impedance at the bridge signal frequency. It also must be able to carry the d-c test current safely and without saturation. The d-c ammeter or milliammeter, M, reads the current through the unknown inductor and bridge arm R_3 in series. In most practical applications, however, R_3 will be small and thus will not increase the d-c voltage demands unnecessarily.

At null: $L_x = \dfrac{R_1R_3C_2}{1 + (R_2\omega C_2)^2}$. When the losses in the coil are low, that is Q is greater than 10, $L_x = R_1R_3C_2$. $R_x = \dfrac{R_1R_2R_3\,(\omega C_2)^2}{1 + (R_2\omega C_2)^2}$

Resistance-Substitution Method. The circuit shown in Figure 4 is especially useful for a quick laboratory bench setup but it is applicable also to a permanent instrument. It employs the familiar calibrated-resistor method for determining impedance, and inductance later is calculated from this impedance.

Resistance R is a calibrated variable resistor and may be either a direct-reading rheostat or a decade box. However, it must be able to handle safely the direct current which is passed through the coil, L_x, under test and indicated by meter M. The a-c test signal is superimposed upon the direct current. The secondary winding

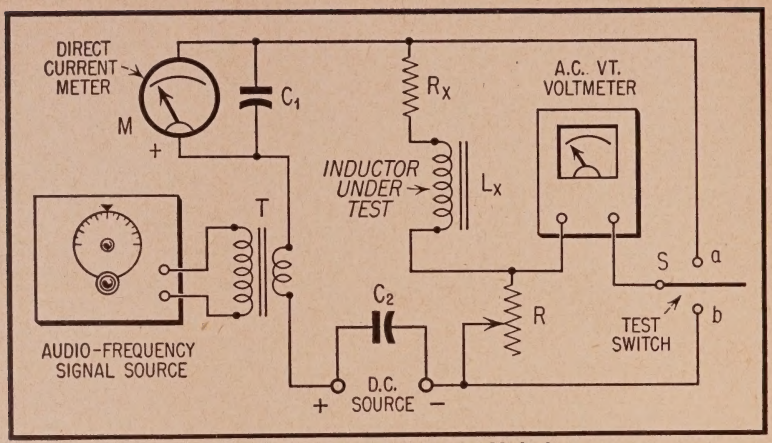

Fig. 4. Resistance Substitution Method.

of the isolating transformer, T, must be able to carry the dc safely and without saturation. Capacitors C_1 and C_2 bypass the test signal around the meter and d-c supply, respectively. L_x is the inductance of the coil under test and R_x its internal resistance. The null detector may be an a-c vacuum-tube voltmeter, as shown, or an oscilloscope.

The following test procedure is recommended: (1) Before connecting the unknown coil into the circuit, measure its d-c resistance, R_x, accurately. (2) With the coil in the circuit, adjust the direct current, as indicated by meter M, to the desired level. (3) Throw switch S to its position a and note the value of the voltage drop across L_xR_x. (4) Throw switch S to position b and adjust R to obtain the same voltage read in Step 3. (5) Return S to a and readjust R. (6) Due to the new setting of rheostat R, the d-c voltage must be adjusted to restore the direct current level. (7) Continue to shift S alternately between a and b while adjusting R, until there is no change in the voltmeter deflection as this switch is thrown back and forth. (8) At this point, the impedance (Z) of the coil under test is equal to the resistance setting of rheostat R. That is, $Z = R_x + jXL_x = R$. (9) From this, the unknown incremental inductance may be calculated:

$$\frac{\sqrt{Z^2 - R^2_x}}{6.28\ f}$$

Where f is the test frequency in cycles per second.

Bridged-T Network. Figure 5 shows a circuit for measuring incremental inductance in terms of capacitance and frequency. Like the a-c bridge, this is a null-type circuit.

The a-c and d-c supplies are connected in series. Capacitor C_3 bypasses the d-c supply at the test-signal frequency. Capacitors C_1 and C_2 are identical and variable. A dual capacitor decade system is convenient for use in this position. R_s is a calibrated rheostat or a decade box. Inductor L_x is the coil under test and R_x its internal resistance. The direct current flows through L_x, meter M, and the primary of the coupling transformer, T, in series. The transformer must be able to carry this current without saturating.

With the a-c test signal set to the desired frequency and the direct current adjusted to the rated value for

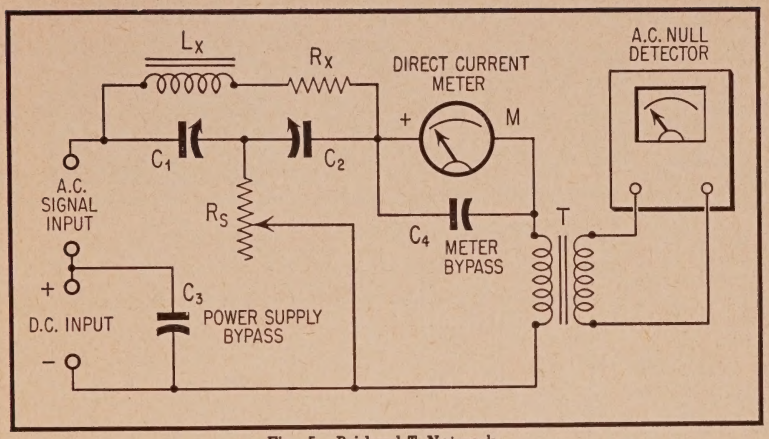

Fig. 5. Bridged-T Network.

the coil under test, capacitors C_1 and C_2 are varied simultaneously for null, as indicated by the detector. Rheostat R_s then is adjusted for improved null. C_1 and C_2 then are readjusted. At null, $L_x = 1/(3.14fC)$, and $R_x = 1/R_s(6.28fC)^2$.

The range of capacitances C_1 and C_2 must be chosen such that $C/2$ is the capacitance which would be required to resonate the expected inductance of the coil at the test frequency. A wide-range resistor should be used at R_s in order to guarantee good coverage of the test circuit.

Time-Constant Method. In each of the common circuits for measuring incremental inductance, the direct current flows through one or more components in the test circuit. This is a matter of concern, since the current-carrying component must be rated to withstand safely the highest current of interest. In instances where a series choke is employed to isolate the d-c supply, as in Figures 2 and 3, or when a coupling transformer is specified, as in Figures 4 and 5, these components often must carry such very large direct currents that their size becomes unwieldy. When the direct current reaches the order of amperes, it becomes impractical to use either series chokes or coupling transformers, and the various bridges and null circuits decrease in utility.

In such instances, the time-constant method of measuring incremental inductance is invaluable. This is based upon the current buildup in a series RL circuit. Figure 6(A) shows the test circuit and Figure 6(B) the response curve. The coil under test is connected in series with a switch, direct current meter, and recording oscillograph. The most satisfactory oscillograph for this application is the type making a photographic record and having a calibrated time base. However, a camera-fitted d-c oscilloscope can be used if it has a time base calibrated in milliseconds and is equipped with low-input-resistance amplifiers. Switch S must be a heavy-duty, positive-action unit, such as a mercury switch, which has no bounce or chatter.

In the test circuit, inductor L_x is in series with a resistance, R, which is comprised by the d-c resistance of the coil and the input resistance of the oscillograph. The value of R must be measured beforehand. In any series RL circuit, the current cannot reach its maximum, steady value instantaneously

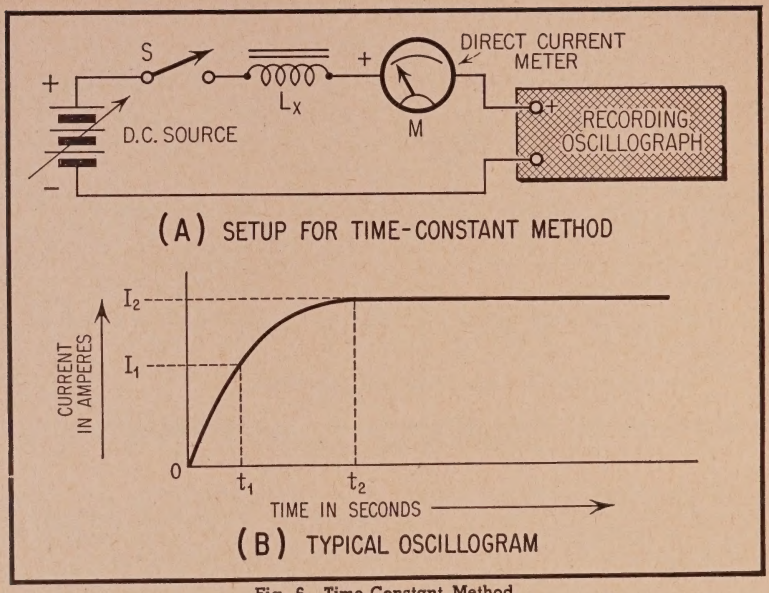

Fig. 6. Time-Constant Method.

upon application of the voltage but builds up to this value in the interval following the closing of the switch. Thus, referring to Figure 6(B), the maximum steady value of current is I_2. When the switch is closed, the current builds up from zero to I_2, as shown by the left-end curvature, finally reaching I_2 at time t_2. By definition, the time constant of the circuit is $t = L/R$ seconds, where L is the inductance in henries, R the resistance in ohms, and t the time (t_1) in seconds required for the current to reach a value (I_1) equal to 1-(1/2.7183) of its final value (I_2). This corresponds to 63.2% of I_2. To determine the inductance from the response data, the formula may be rewritten $L_x = Rt$. Time t is determined by measuring the interval between zero and t_1 on the oscillogram (Figure 6B) corresponding to the measured current interval, from zero to I_1, equal to 63.2 percent of I_2.

To make the test: (1) Measure accurately the d-c resistance of the test coil and of the oscillograph input. Add these two together to obtain the value of R. (2) Set up the circuit as in Figure 6(A). (3) As a preliminary step, close switch S and adjust the d-c voltage for a deflection of meter M equal to the current level at which the coil is to be tested. (4) Open switch S and start the oscillograph. (5) Close the switch solidly and allow a few seconds run of the oscillograph. (6) Obtain the oscillograph record. (7) On the vertical axis of the record (which will resemble Figure 6B), measure I_1 equal to 63.2% of the maximum steady current level, I_2. (8) Project the intersection of I_1 with the trace to the horizontal axis to obtain point t_1. (9) Measure the distance from zero to t_1 to obtain the time interval t_1. Most oscillographs have a milliseconds-per-inch or milliseconds-per-centimeter calibration. (10) Determine the unknown incremental inductance from the formula $L_x = Rt_1$.

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SELL OR SWAP — BC-669 Radiotelephone (100 w.), includes AC power supply, handset, amateur and marine crystals, cables, manual, exc. cond., ready to operate. Best offer. L. Clements, Box 342-16, Crete, Ill.

WANTED — A, B, C, and D coils for National HRO 5 rcvr; and parts list for Pierson KP81 rcvr. Charles R. Mersereau, 31 Pomona Ave., Fairlawn, N. J.

FOR SALE — National NC-125 receiver, with matching speaker, perfect cond. Best offer. R. H. Hanson, 204½ South North St., Fairmont, Minn.

FOR SALE — National HRO-50-T receiver with all coil drawers and matching speaker, like new. R. Schilling, 9 Zeliff Ave., Little Falls, N. J.

FOR SALE — Precision 915 tube tester, fair cond., $30; AC-DC photo motor, $10; 4-band Zenith console radio-phonograph, $25; 3-way Sentinel portable radio, $11; CD converter 500 w., $25. J. Kramer, 229 East 7th St., New York 9, N. Y.

WANT — 20-25 w. mobile xmtr., 75 mtrs, xtal controlled. Larry Smith, Kingston, N. C.

FOR SALE — Candler Code System and all but first record of Ameco Elementary Code course, $15; $150 worth of Radio Control model airplane equipment, $65. John Steiner, Rt. 7, Johnson City, Tenn.

FOR SALE — Presto Y4 professional disc recorder, 2-speed, A-1 cond., $300 cash. Star Electric Co., 5139 Superior Ave., Cleveland 3, Ohio.

SELL OR SWAP — Lysco 600, $55; 6 v. dynamotor 425 v. at 375 ma., $12.50; Meissner 8C FM tuner, $20; Sonar 10-meter mobile rcvr., $45. Want Heath DX-100 and 6-meter xtal controlled converter. Arthur Crissey, Sparta, N. J.

TRADE — BC-459 40 meter CW xmitter, TVI proofed, for Astatic D-104 mike. Also have 3' open relay rack; ARC-5 dual xmitter rack; and triple receiver rack. R. C. Williams, 2236 Parkway Dr., Winston-Salem, N. C.

WANTED — Overhead recording lathe, 12" or 16", with or without recording head and turntable. Need not be in operating cond. Richard Seinfeld, 5834 Pershing Blvd., Houston 21, Tex.

SELL OR SWAP — 201-A tubes in original cartons, also 199-WD-12 and others. Want old-time radio magazines and books, old circuits. Raymond Fisher, 627 Fallowfield Ave., Charleroi, Pa.

SWAP — Kalart I camera, 3 lenses, case, flash accessories (value $250). Want equivalent value communications rcvr. Clifford Storch, 5 Winfield Terr., Great Neck, N. Y.

SELL OR SWAP — BC-221-AK frequency meter tone mod.; 500 w. TVL plug-in coils, 80 - 40 - 20 - 10 m.; 50 kc. IF transformer. Want mobile transmitter, 160 m. thru 10 m. and Super Six conv. Frank Weber, Coldwater, Kan.

FOR SALE — Heathkit AR-2, 535 kc. to 35 mc., hardly used, best offer. Want Colordapter parts (Jan. '56, Radio-Electronics), auto license tags of dominions and states. R. L. Evans, Jr., B-212, RPI, Troy, N. Y.

FOR SALE — Hickok model 202B VTVM, with new tubes, and 2 sets of probes; Bradshaw model 10 VOM with probes, needs face glass. Both good cond., best offer. Bernie's Radio-TV Service, 803 Hopkinson Ave., Brooklyn 12, N. Y.

FOR SALE — Unused Sylvania type 131 oscilloscope, and type 139 tube tester; and Simpson 315 sig. gen. Reasonable. Paul R. Fortin, 113 Stanton Ave., Baldwin, L. I., N. Y.

FOR SALE — Discontinued type receiving tubes in original cartons — CX-300-A, CX-301-A, CX-112-A and UX-171-A. H. W. Schultz, 1102 Sixth St., Beloit, Wis.

FOR SALE — GE model YTW-1 tube tester with test leads, $25; Emco model 103 Voltohmeter, $15. Both like new. John W. Heckman, Summerville, Pa.

FOR SALE — Eico 320 sig. gen., like new, $22.50; Video Handbook, Audels Radioman's Guide, Radio Data Book, all like new, $14; two Fada 3-way portable radios, operating cond., $14 FOB. Lowe E. Smith, R. 1, Trion, Ga.

FOR SALE — Clough-Brengle model 127 combination scope and frequency modulator, good cond., $35; Precision model 920P tube tester, good cond., tests all tubes, $60. Paul Capito, 637 W. 21st St., Erie, Pa.

FOR SALE — Two like new Philco CR6 auto radios. Make cash offer FOB; one control for Chevrolet; other for Chrysler, Dodge, DeSoto, Plymouth, 1941-42-46-47. Samuel Fels, 612 Rogers Avenue, Brooklyn 25, N. Y.

WANT — '37, '38, '39 ARRL handbooks; 1921, '22, '23, '38 call books. C. Fernandez, 81 Warren St., Roxbury 19, Mass.

FOR SALE — Hickok VOM, good cond., $25; Teleking TV 16" table model, $50, good cond.; Challenger 600 intercom, $12. J. C. Bechtler, 23-79 206th St., Bayside 60, N. Y.

WANTED — Hickok 156-A traceometer; complete UMS TV Home and Auto radio manuals, complete with service tips, 1941-1956. Paul Capito, 637 W. 21st St., Erie, Pa.

FOR SALE — Sams Photofact folders, 1 to 114 and 121 and 122. Have binders for 110 folders. Like new, $125 plus shipping costs. William A. Bundrant, 609-25th Place West, Eugene, Ore.

FOR SALE — Heath bar generator, BG-1, like new, $6. Julio Bellber, 503 W. 174th St., New York 33, N. Y.

SELL OR TRADE — Schematic diagrams ART-13, BC-221, BC-348, BC-312, T-23/ARC-5, and others. Also surplus tubes and equip. S. Consalvo, 4905 Roanne Dr., Washington 21, D. C.

WANTED — Lampkin 105B frequency meter and 205 Modulation meter. Must be in good cond. and priced for quick cash sale. Bob's Radio and Hobby Shop, 601 NW First St., Walnut Ridge, Ark.

FOR SALE — Superior Powerstat model 116-V, 7.5 amps, 0-140 v., in original sealed carton, $9; Simpson model 57 AC 0 to 500 v. meter. Still in sealed carton, $7. Fowler Electric Co., 444 Jackson St., Joliet, Ill.

FOR SALE — 16" GE mahog. table model 16T6, 20 tubes, good condition, $24.95. Will ship anywhere. Jones Radio, 1115 Rambler Ave., Pottstown, Pa.

WANTED — Electronic tubes, all types — receiving, transmitting, special purpose. Cash paid. William Schechter, 62 Cortlandt St., New York 7, N. Y.

WANTED — Frequency Standard. Hammarlund, FS-135-C. Leo P. Lastuvka, 1044-19th St. SE, Cedar Rapids, Iowa.

WANTED — For Cash: Sams Photofact folder sets 226 and then 228 thru 249. Give cond., if in binders, and price. Earl W. Wells, 223 North Philadelphia St., Shawnee, Okla.

FOR SALE — Lavoie Lab frequency meter, 300-600 mc., without batteries, A-1 cond. Best offer. H. W. Callaway, 2555 Blvd. Dr. SE, Atlanta 17, Ga.

FOR SALE — 6 v. Leece-Neville, complete with VR. rect. and harness, $50; 10 meter mobile (composite) transmitter with mike (ceramic), $25; Morrow 3 BR with (composite) FTR, AVC, BFO, RF gain, $60. All FOB. Harry M. Boone, 200 Brightside Ave., Pikesville 8, Md.

WANTED — Good transmitter, or parts. State power and construction. John Seaman, 1109 Main St., Hellertown, Pa.

SELL OR TRADE — Lysco 600, good cond. Need 4D32 tubes, stamps. Bill Grebe, 518 W. 9th, Loveland, Colo.

WANTED — FM and AM tuner, or tape recorder. Will trade 139 Sylvania tube tester or purchase outright. Richard F. Meates, Slinn Ave., Spring Valley, N. Y.

FOR SALE — Heathkit receiver AR-2 with cabinet, pilot light, accessory sockets for Q-multiplier, $25 FOB. Samuel Birken, 1050 Wheeler Ave., Bronx 72, N. Y.

FOR SALE — ICS Radio and Television correspondence course. Victor Stella, 429 East 147th St., Bronx 55, N. Y.

FOR SALE — $70 pair of wireless intercoms, never used, sacrifice both units for $45. R. Lackner, 2029 Bradley, Chicago 18, Ill.

TRADE — 17" TV console, for late ham gear. Need all-band factory transmitter and receiver. K. H. Stello, 4504 Hartwick Rd., College Park, Md.

FOR SALE — RCP model 322 tube tester, $17; Eico model 221A VTVM, $20; Hammarlund Comet Pro receiver with all plug-in coils, $25. All in perfect working order. John P. McCullen, 3050 Bainbridge Ave., Bronx 67, N. Y.

SELL OR TRADE — Nikon lens, 135 mm., 28 mm., varifocal, filter, electronic flash unit, used only 2 months. Want good ham receiver or ? Norman LaCroix, 392 Benefit St., Pawtucket, R. I.

FOR SALE — GO-9 xmitter minus meters, not converted for AC, $20; British Marconi aircraft receiver, 75 kc. to 18 mc., BC-221-M chassis only, LM-10 minus calibration book. Make cash offer. Theodore M. Korch, 612 Sycamore St., Rahway, N. J.

WANTED — Copy of U. S. Navy Book by Bureau of Ships on Cross Reference Index on Electronic Tubes. State price, condition, and publication date in first letter. Sid Levin, 4217 Okalona Road, Cleveland 21, Ohio.

TRADE OR SELL — Complete tools, catalogs and manuals for washing machine repair business, for tape recorder, 10½" reel, 7½ IPS. Z. T. Bogar, Burtonsville, Md.

WANTED — Complete Radio-TV course, without kits. Send information on price, age and cond. J. W. Parker, Jr., Box 356, Bennettsville, S. C.

WANTED — Johnson Ant. Match-Box, 6-12 v. DC battery eliminator, TU75B 6 meter transmitter, small variac, single sideband equip. Will pay cash or trade TV test equip. Bob Franks, 715 Broadway, Bedford, Ohio.

WANTED — Radio crankup mast, steel or aluminum, 40' to 60', for house side attachment, less guy wires, similar as Alprodco CU-56S. Ivan Mamarchev, 1115 Worthshire, Houston, Tex.

SELL OR TRADE — DB-20 Preselector, recently factory reconditioned, $30, or will trade for good FM radio. Richard Daneker, 316 E. 2nd St., Lansdale, Pa.

WANTED — For Cash: TV test equipment and Riders TV manuals. Send make, model, price, age, and condition. J. P. Chamberlain, 4898 Dec Rd., Memphis, Tenn.

WANTED — Good tube checker and sig. tracer. Kenneth Miller, 10027 Calvin St., Pittsburgh 35, Pa.

SELL OR TRADE — Sig. Corps BC-412B scope, 110 v. AC, $25; 630 TS chassis, $65; Hallicrafter S-38C, $25. All in good working condition. J. Mrofchak, 1687 Daley Rd., Lapeer, Mich.

WANTED — Old microphone cases, without xtal, with good outer appearance, similar to Astatic JT Series inside size. Will offer up to $2.50 each or will repair xtal mikes for cases. Laidley & Bammes Radio, 1280 Court St., Redding, Calif.

WANTED — Transformers, 10 to 28 volt output, 5 to 50 watt, center tapped or not, 1 to 10 amp., 117 v., 60 cy. Lowest or swap tubes, books, etc. Electronic Service Co., Box 9-231, Richmond 27, Va.

SELL OR SWAP — Weston model 594 photo-cell and model 813 relay with double magnetic contact and solenoid reset; unused BC-645 with conversion dope. Want tape or wire recorder. Prefer local. M. Youngman, 515 South Blvd., Oak Park, Ill.

FOR SALE — RCA 10" TV model 9T246, with cabinet, minus 4 small tubes, clean cond., needs alignment. Make offer. Ben Cheskis, 2661 North Napa Street, Philadelphia, Pa.

SELL — Super Pro 110 LXR with power; VTVM EV-10S with RF probe; pair 810's, 815, 832, 100THs; BC-221, wood case; Hickok 288X. Scott Radio-TV, Washington St., Bunker Hill, Ill.

WANTED — 0-50 microammeter, 2" preferred, or Weston 772 analyzer, if meter is OK. Have BC-453 (Q5er) Command receiver in carton to swap or will sell. George N. Schaefer, R. 3, Lee's Summit, Mo.

FOR SALE — Webcor 80 wire recorder and accessories, good cond., $40; 400-500 megacycle transmitter and receiver GE BC-645A, good cond., with tubes, $18. Gene Brizendine, 1001 Merritt St., Old Hickory, Tenn.

FOR SALE — Sams Photofacts 1 thru 140, like new, $70; Radio City sig. gen., model 704, good. Make offer. Want late model tube tester. John L. Beamer, Homeworth, Ohio.

FOR SALE — Hallicrafters SX-88 2nd production run, perfect cond., $445; WRL Globe King, model 500, like new, $550. Will consider swaps for cheaper commercial mobile xmtr and rcvr. R. S. Sturman, 1241 Virginia Ave. NE, Apt. D-4, Atlanta 6, Ga.

WANTED — Vol. 1 to 10, all issues, C-D Capacitor, and Vol. 11, Nos. 1 thru 8, inclusive. T. T. Crittenden, Box 3056, San Diego 3, Calif.

FOR SALE — Good old type tubes, almost any type number. Bargain price on whole lot. William H. Henshaw, 46 Front St., Tarrytown, N. Y.

WANTED — Meissner model 8C FM tuner, with or without cabinet. State lowest price postpaid. R. M. Navon, 6210 20th Ave., Brooklyn 4, N. Y.

FOR SALE — Lysco model 600G Transmaster with lo-pass filter, guaranteed no TVI, 160-10 meters, $70; General Radio variac 2KVA, 115 v., 60 cy., 18 a. type 100-Q unused, $30. Prefer local. Gene Reynolds, 4063 Lasher Rd., Drexel Hill, Pa.

SELL OR TRADE — 1500 unused teletype parts. Want LP records, Hi-Fi speaker, 3-speed changer, teletype, small chain saw. D. C. Weber, Box 582, Ft. Myers, Fla.

FOR SALE — Automatic keyer Signal Corps surplus (TG10J), 0-25 words; Approved Electronics field strength meter, A-460; Electronics Development 3" scope, model 41; Blonder-Tongue DA2-1 distribution amplifier; GE YTW-1 tube tester. Village Radio, 454 W. 129th Pl., Chicago 28, Ill.

SELL OR TRADE — 1250/1000 v. DC, 300 ma., all Thordarson dual choke input fil., dual 0-200 v. DC bias supply same chassis, overload rel., highest quality components. Very good cond. Lawson, 4010 River Dr., Houston 17, Tex.

WANTED — Professional tape recorder, like Ampex or Twin-Trax; also want factory wired 5" scope. C. J. Hire, 81 Parkwood Blvd., Mansfield, Ohio.

WANTED — Riders manuals and Sams Photofacts; Precision counter or portable checker with VOM, etc. Cash or trade. A & D Radio Shop, 2530 W. Colorado Ave., Colorado Springs, Colo.

SELL OR TRADE — Two matched solid aluminum Robinson 16" transcription tone arms, only weight on record is that of cartridge, will not break up set. Want portable typewriter. R. N. Brunt, 61 So. Spring St., Elizabeth 4, N. J.

TRADE — Unused Nucleometer, or other Nucleonics for Collins 32V series transmitter. Joseph F. Abate, Box 392, San Carlos, Calif.

FOR SALE — 10" RCA TV model 630 in working condition, $20 cash. William Miraldi, 84-56 86th Ave., Woodhaven 21, N. Y.

WANTED — Mobile VFO xmtr and receiver for under dash mounting in new car. Must be reasonably priced. Marvin Kaplan, 2715 Broad St., Easton, Pa.

FOR SALE — Kohler light, 800 w., 115 v., 60 cy., like new, $175. Trade for Sams manuals above 100; from 100 to date in cabinet, will pay difference if set is complete, and some other service info included. Walter K. Fralick, R. 1, Marion, Ky.

WANTED — R5/ARN7 radio compass in any cond., will swap electronic gear or pay cash. Rudolph P. Fannon, 134 Highland St., Marlboro, Mass.

SWAP — Oliver No. 5 typewriter in good working shape for condenser tester, such as C-D Type BN or Sprague KT-1. George Mashek, R. 2, Box 45, Marissa, Ill.

SWAP — 1946-1949 Olds radio, one piece. Want record player, good condition. D. Sweet, 138-35 Jewel Ave., Flushing, N. Y.

TRADE — Eico equipment: scope 425, VTVM 221, sweep generator 360; also 17" Admiral TV set. Want good Hi-Fi amplifier, AM-FM tuner and speaker of equal value. Local preferred. Sam Small, 760 Magenta St., Bronx 67, N. Y.

WILL BUY — Any information, material, books and literature pertaining to the repair and maintenance of juke boxes. Yale Phonograph Co., Box 1162, Tampa, Fla.

WANTED — Sams Photofacts folders, must be complete. State price. Lucien Michand, 303 Belaire St., New Bedford, Mass.

FOR SALE — Sept., 1945, to Aug., 1947, complete copies of QST. Sell or swap for Radio-TV equip. R. Vosbury, 38 Andrews Ave., Binghamton, N. Y.

FOR SALE — Completely wired model SG-8 Heathkit sig. gen., 3 mos. old. Best offer. Edward Bowley, 31-19 43rd St., Long Island City 3, N. Y.

FOR SALE — ATI-TV booster, best offer over $15; 16" console and 17" table model Admiral TV, best offer over $50. All serviced and guaranteed. Jones Radio-TV, 924 Racine St., Racine, Wis.

FOR SALE — Vols. 1 thru 17 Riders manuals, including index. Make offer or swap. W. Hanlon TV Service, 2538 Standish Ave., Union, N. J.

SELL OR TRADE — Like new well-known make TV boosters, and 0-300 DC milliamperes meter. Need portable typewriter, tube tester transformers. Bob's Radio-TV Service, 67 Lafayette Street, Plattsburgh, N. Y.

SELL OR TRADE — Hobbyist or experimenter Supreme 546-A 3" oscilloscope, good working order, instruction manual included, $15 or ?? No dealer, will not ship. Norman Wright, 930 East Grand St., Elizabeth, N. J.

FOR SALE — GE tube tester TC-3P with four adaptors, $12. E. McGee, 41 Birch St., Worcester 3, Mass.

SWAP — Unused Heath sig. tracer with leads, instructions and diagrams, postpaid anywhere in U. S., for like new National type NPW-0 or PW-0 micrometer dial. Melvin Usimaki, 603 Mann St., Marinette, Wis.

WANTED — Webcor 210 or Revere T-700 tape recorder. Give all particulars. Eugene Kon, 1516 Broadway, Buffalo 12, N. Y.

WANTED — Precision 612 tube tester. State price and condition. Luck's Radio-TV Service, 57 E. Buttonwood Ave., Pine Hill, N. J.

FOR SALE — Pro sig. tracer, $20; National cash register, $45; pic tube rejuvenator, $9. G. R. Lance, 1557 No. 17th St., Omaha 10, Neb.

SELL OR SWAP — APS-13 in original packing case, APN-4 indicator with all tubes, two old-style hand-crank wall telephones, like new 78 rpm phono motor. Want FM tuner, 2-meter xmtr, LM frequency meter, TBS xmtr, etc. Robert L. Ludlum, 824 San Miguel Rd., Concord, Calif.

SELL OR SWAP — Older style Wurlitzer juke box with 78 rpm changer and 14" speaker. What have you? Linwood R. Clay, 6 Groveland St., Haverhill, Mass.

FOR SALE — PE-110 power supply in OD crate, $55; SCR-522 xmtr-rcvr, converted with dual power supply in enclosed cabinet, latest model, $145. Need ART-13 and Wilcox CW-3. Phil Greenway, 1740 North Ave. NW, Atlanta, Ga.

WANTED — Low frequency receiver BC-453 and schematic (need not be working or converted), conversion manuals Vol. 1 and 2. Marvin Gurlin, 111 White Horse Pike, Audubon 6, N. J.

WANTED — 3" Espey TV receiver. State condition and price. Wilbur Bolt, 932 North St., Allentown, Pa.

WANTED — Complete set of books and texts from NRI course not more than five years old. State price. Thomas B. Ward, 4126 Perrysville Ave., Pittsburgh 14, Pa.

WANTED — Good used 3-speed automatic record changer for cash, or trade counter tube checker, roller chart, checks up to and loctal tubes. Arthur Miller, 2325 No. 22nd St., Lafayette, Ind.

SELL OR TRADE — Radion Field Strength Meter model FSM 5000, UHF and VHF, used about 6 hours; Feiler TS-3A electronic stethoscope; RCP 705A sig. gen., $15 each. James H. Harris, Route 1, Newburgh, Ind.

FOR SALE — Like new Navy RU-18 aircraft radio receiver, 8-coil set with dynamotor filter, $25; Webster-Chicago automatic record changer, plays through radio, A-1 condition, $15. Merle L. Henske, 505 Dayton St., Omak, Wash.

TRADE — Surplus aerial film 9½" wide, for gun camera, camera, or ham equipment. Jim Wright, 2319 E. Indianola, Phoenix, Ariz.

FOR SALE — Riders Vols. 5-7, 9-11 and 14; TV, Vol. 1. Make offer. Unused oil conds., 3 mfd, 4,000 v., $4; 2X.1 7000, $20. Al Svirmickas, 2512 West 69th, Chicago 29, Ill.

FOR SALE — Like new Eico sweep gen., less crystal and case; and Eico scope, less 5" tube and case, both for $35 or best offer. Frank Scatoni, 143-28 97th Ave., Jamaica, L. I., N. Y.

SWAP — 2-meter crystal controlled FM transmitter and receiver, 117 v., 60 cy. input, for National 1-10 or 1-10A with coils or National HFS. State condition. E. V. Blaize, Jr., 2324 Mexico St., New Orleans, La.

FOR SALE — Battery-AC portable radio, Andrea 6G63, 5-tube, rectifier, broadcast and 2 short wave bands, 2 to 6, 6.5 to 18 mc., spare wave band switch, $5. Maurice C. Superville, 4614 Huisache St., Bellaire, Tex.

WANTED — RME DB-22A preselector. John R. Willis, Passaic Ave., Caldwell, N. J.

SELL OR SWAP — ART-13, with AC supply, $200 or best offer; Abbot TR-4 2-meter transceiver, $20; RCA 152-172 megacycle xmitter and receiver, $50 each; Bendix TA-12 50 w. xmtr, $25; complete Motorola mobile rig, $65. B. Higley, 82 Lower Main St., Matawan, N. J.

FOR SALE — QST complete 1934 to 1955; plus 100 odd copies between 1921 and '55; CQ 50 odd copies 1945 to '55. C. H. Campen, 421 Wickham Rd., Baltimore 29, Md.

WANTED — Converter and other mobile ham equipment. What have you? Alvin Schugam, 4911 Haddon Ave., Baltimore 7, Md.

FOR SALE — Riders manuals, Vols. 1-16, $50; Regency TV booster, $7; Precision E-200 sig. gen., with test leads and instruction book, $35, prepaid. All in exc. cond. William Thoma, 139 South Delmar Ave., Dayton 3, Ohio.

FOR SALE — RCA KRK-12A tuner, VHF and UHF, never used, in perf. cond., with schematic, less tubes, $10 postpaid. Louis Koczela, 246 Third St., Elizabeth 1, N. J.

FOR SALE — Little used Precision E-200C sig. gen., $50; Riders No. 14, like new, $10; other radio manuals, and older type tubes. L. Bruckner, 122 Highland Pl., Monrovia, Calif.

WANTED — Kaar Model PRS-9A receiver. J. S. McIntire, Jr., 39 West Monument Ave., Dayton 2, Ohio.

TRADE — Almost new .22 rifle Remington Sporter model 513-S; Craftsman 7¼" power portable saw with carrying case. Want test equipment, tape recorder. E. A. DeCobert, Jr., 609 Henrietta St., Gillespie, Ill.

SELL OR SWAP — Tube testers: Hickok model 600A, $65 and Supreme, good condition, $15; table model radios, less tubes, $4 each; 12½ Philco table model 50T1403, good cond., $22. Alex Poch, Box 174, Dillonvale, Ohio.

SITUATION DESIRED — 2nd Phone Man now studying broadcasting, desires work in AM-FM TV station; past experience in servicing field; age 27, 4F, married; willing to relocate. Gene Mick, 1332 71st Ave., Philadelphia 26, Pa.

SWAP — Collins TCS-12 xmitter and rcvr with 110 v. AC power supply. What have you? Wiltz C. Hanks, 912 So. Avenue H, Crowley, La.

FOR SALE — Hickok 177X sig. gen.; Hickok 195B scope, both like new in original cartons, with manuals and leads. Best offer. You pay shipping. Ben Martin, 200 Pennsylvania St., Peoria, Ill.

WANTED — Sams Photofacts, in original binders, 75c each; also late-dated receiving tubes. C&W Television, 9 Chase Park Ave., Waterbury, Conn.

SELL OR TRADE — Back issues of QST, almost complete from 1925 to 1931, also a few issues of 1923 and 1924. Want ham equip. Edward A. Block, Route 4, Grandview, Tex.

SELL OR TRADE — Precision E-400 sweep gen. Want Heathkit 09 scope or similar. Gregory Swiska, 109 East School St., Woonsocket, R. I.

WANTED — Clean back issues of QST and CQ magazines, about 1946 and later. William H. Steffey, Route 5, Staunton, Va.

WANTED — Precision model 10-12 or Hickok 605 or 600 tube tester, also sweep gen., state price, cond. Frank Kelczewski, 1012 Bill Rd., Schenectady, N. Y.

SELL OR SWAP — 12½" Philco TV; Webster-Chicago model 78 wire recorder; Radio Craftsmen RC10 amp. with 8" speaker. Want good tape recorder or cash. W. Landau, 40 East 17th St., Brooklyn 26, N. Y.

SWAP — Eico 320 sig. gen., 150 kc. to 102 mc. with instruction manual, for Heathkit VFO model VF-1. Joe Jones, Box 232, R. 1, Clarks Summit, Pa.

WANTED — Short wave receivers. Have UHF converter, Weston tube checker to trade. R. E. Bridges, 217 Lineberger St., Shelby, N. C.

FOR SALE — NRI model 88 sig. gen., 170 kc. to 60 mc., includes instructions, $20. Carl Haas, RD 2, Coopersburg, Pa.

FOR SALE — WE 509 headphones cord tips, telephonics TH37 2 cords jacks and tips; 2 sets IBM with tip cords, Aastatic 200S hand switch mike. All like new. Make offer. Peter Carriero, 2260 Haviland Ave., Bronx 62, N. Y.

FOR SALE — R. L. Drake TV-300 low pass filter for 300 ohm line. Will handle one kw, $5 plus postage. S. A. Cranker, 37 Warren St., Warrensburg, N. Y.

FOR SALE — Johnson Viking Ranger transmitter/exciter, like new; Hammarlund HQ-129-X communications receiver with speaker in exc. cond. Norman Jacoby, 217 East Mount Eden Avenue, Bronx 57, N. Y.

WANTED — 7JP4 7" TV or portable TV set. Will trade tubes, parts, or pay reasonable price. Harry Gursh, 1481 Shakespeare Ave., New York 52, N. Y.

FOR SALE — Riders radio manuals, 1 to 20; and TV 1 to 7, like new, $125; 500 assorted resistors, $15; construction plans for 10 w. Hi-Fi amplifier, $1.50. Wolins, Amazon Rd., R. 2, Peekskill, N. Y.

FOR SALE — Monitor Police Alarm Radio 30 to 50 mc FM model PR31A in exc. cond., local preferred, $25. Hy Knoller, 1590 E. 22nd St., Brooklyn 10, N. Y.

FOR SALE — Back issues: Radio, Jan. '40 - Dec. '44; CQ, Jan. '45 - Dec. '49; QST, Jan. '40 - Dec. '49 (Dec. '44, Sept. '45 missing). H. W. Lingenfelter, 21352 Kenwood Ave., Rocky River 16, Ohio.

FOR SALE — Hickok 670 5" scope in new cond. with all cables and books, has had less than 3 hours use, $150. Mack Spizer, Thermador Elec. Mfg. Co., 5119 District Blvd., Los Angeles 22, Calif.

FOR SALE — Electric Specialty "Bug" key, $12; Hammarlund Comet Pro rcvr with all coils, $35; miscellaneous QSTs, Radio, CQ from 1920 to 1951. M. J. Douglas, 1401 Amador St., Concord, Calif.

FOR SALE —Eldico TR75 TV transmitter with 40 w. modulator, 80, 40 meter coils, 5 crystals, best offer over $75. Heath AT-1 xmitter with VFO and antenna coupler. Make offer. All like new, sold only as complete units. Harold Loffler, 533 Main, Ogdensburg, N. Y.

TRADE OR SELL — Collins 310C, $90; 12 ft. aluminum tower; prop pitch motor and selsyns. Samuel Lieberman, 130-29 228th St., Laurelton 13, N. Y.

WANTED — Metal cabinet to fit Hallicrafters SX-28 receiver — front panel 8¾" by 19", depth 14¼"; also 3" round "S" meter for SX-28. Alan York, 35 Main St., East Hampton, N. Y.

TRADE — CWD-21AAX (PE-101C) dynamotor, reconditioned, perfect. Need 2500 v. oil-filled condensers. Byron Fortner, R. 10, Box 486, Indianapolis 19, Ind.

FOR SALE — Riders Vols. 1 to 17 inclusive, with index, good cond., $5 each or $85 in all, plus transportation. Radio & Supply Co., 2208 No. Saginaw, Flint 5, Mich.

FOR SALE — Heath model 0-7 scope, used very little, $25; have other Heath instruments. V. R. Valley, 4318 Banks St., New Orleans, La.

FOR SALE — Tubes: 1G4GT, 1E7GT, 1J6G, 1H4G, 1G5G, 1D5GP, 1F7G, 1C7G, 1B5, 1A4P, 1A6, 2A5, 2A6, 6V7G. Raymond Matousek, Radio Service, Jennings, Kan.

WANTED — Police Alarm model PR9 or Hallicrafter S95 Civil Patrol. Have Heath audio osc. and Howard FM conv. W. Fuller, 3137 W. Michigan Rd., Dimondale, R. 1, Mich.

WANTED — RCA UHF converter, stock No. 164. Give price and cond. Philip B. Latimer, Clarksville, Ark.

SELL OR SWAP — Set Hammarlund Super-Pro receiver coils; Western Elec. 9-A head, arm and filter; Gray transcription arm and filter; Webster electric Ekotape recorder. Want good reflector telescope or optical gear. V. Barker, Woodside Dr., Freeport, Ill.

TRADE — 12" Zenith console with doors, good condition, for sewing machine. Chicago and vicinity only. Delmar Television, 4425 Fullerton Ave., Chicago 39, Ill.

WANTED — Hallicrafters S22-R Skyrider Marine rcvr., LF-90 converter; Mackay 120-AX, or other rcvrs for 15-500 kc. Charles Nevel, 1017 Tucker, Williamsport, Pa.

WANTED — Monoscope tube, any age or type. Pat Blaney, New Straitsville, Ohio.

FOR SALE — Shure 55A (50 ohm imp.) mike; 2 Clarkstan RV-201 cartridges; Clarkstan 221 equalizer; 3 Pickering S-120M cartridges; G.I. phono motor 2DG4 (78, 33 speed, gear drive). John F. Mitchell, Rt. 2, Ozark, Ark.

WANTED — Tape recorder in good cond.; Hi-Fi equip. for complete system; 2 x 2" slide proj., prefer LaBelle. J. T. Wentworth, 4269 Packingham Dr., Springhill, Ala.

FOR SALE — 2 Wheelco electrical pyrometers, 0 to 2000° F., flush panel mount; 2000 milling machine cutters, endmills, Jacobs drill chucks, tool bits, 1000 ball bearings, all A-1 condition. Henry Schneider,, Box 104, Brooklyn 30, N. Y.

TRADE — 0-27 gauge electric trains, track, switches, signals. Want tube tester in good cond. Arthur W. Buck, 115 Golf Rd., Plymouth, N. C.

FOR SALE — All exc. cond., photos on request: Webster 156 record changer with GE magnetic cartridge, $15; recording mechanisms, GI-R90L $22.50, GI-R85L $25. Milo G. Burston, 320 Tawas St., Alpena, Mich.

FOR SALE — Viking II, Viking VFO, Viking Matchbox, LP filter, Hallicrafters SX-42 receiver, recently aligned, all in top cond., $400, FOB. J. Brownston, 1116 Volz Dr., Sacramento 18, Calif.

SELL OR SWAP — Eico 5" scope; Eico 320 sig. gen.; Dumont 274 scope; Premier 570 gen; BC-221; original calib. charts, AC, DC. Want 35 mm. and 8 mm. cameras, or Hallicrafter S38D or S53A. P. Racine, 1196 Hancock St., Brooklyn 21, N. Y.

FOR SALE — Temco 150G all-band transmitter; chokes; transformers; condensers; meters; Bendix VHF transmitter-receiver; Gonset Tri-band; xmtg. tubes; large variables; SX-28; Command sets. H. S. Gartsman, 2246 Betty Lane, Beverly Hills, Calif.

SELL OR SWAP — Electronic flash unit to operate on 110 AC or flash light cells with output of 80 w. seconds Make cash offer or trade for quality Hi-Fi. S. Rosenblatt, 63-109 Saunders St., Queens 74, N. Y.

SWAP — 16 mm. Cine Kodak Special, with following contact lenses: 25 mm. f1.9, 15 mm. f2.7, and 102 mm. f2.7. Want Collins 32V3 in A-1 cond. Charles A. Albrecht, R. 2, Maxwell Rd., Watervliet, N. Y.

FOR SALE — Globe Trotter, VX101 Deluxe VFO-xmitter, complete mobile xmitter, 812's, 6146's, 2E26's, 6L6's, etc. Will sell all or part for best offer. Albert Miller, 1889 Webster Ave., Bronx 57, N. Y.

FOR SALE — Norelco ProTelegram projection units, with 3NP4, separate or mounted in mahog. cabinets, $60 each. A. Polverini, 116 Rosslyn Blvd., Steubenville, Ohio.

WANTED — Instructors in radio, communications, and television at technical school level, auspices City of New York Board of Education, salary to $7,600, age limit, 60. Contact M. M. Freedman, Samuel Gompers School, 145th and So. Blvd., Bronx 55, N. Y.

FOR SALE — Mobile 6 v., 10 w., 152-162 mc. xmitter-rcvr, complete with mike, antenna and cables, less xtal. Leo Gary, 2600 West 50th St., Chicago 32, Ill.

FOR SALE — Riders: TV Vols. 1 thru 10; Radio Vols. 15 thru 19. No reasonable offer refused. Isadore Cohen, 1511 Boston Rd., Bronx 60, N. Y.

FOR SALE — RCA model 158 oscilloscope, used very little, $50 or good used Winchester 94 rifle. Fred Fleck, 5853 No. Central Ave., Chicago 30, Ill.

FOR SALE — Flyback tester, completely wired, tests without unsoldering leads, clip tester in circuit, guaranteed, $15.28. Armory Radio, 5462 West Chicago Ave., Chicago 51, Ill.

TRADE — Hallicrafters S-38 rcvr.; Air Corps 50 w. transmitter BC-458-A with extra set of tubes, and Army tuning unit TU-5-B, instructions for ham use; 2 carbon mikes T-17-B. Swap all for Hi-Fi amplifier. T. Shriver, Bonner Ave., Nashville, Tenn.

FOR SALE — Leece-Neville 6 v. altinator complete with rect., vol. reg., cables; Bromeco 50 w. trans. 10 m. with Radelco mobile ant., mike, etc. W. Ribol, 125 Roff St., Staten Island 4, N. Y.

FOR SALE — Collins 32V1, $295; Johnson Viking Ranger, $175; RME 45, $60; Hallicrafters S40, $40; 4-ohm 50 w. Sprague Koolohms, $.15 each. John Urban, 140-34 Holly Ave., Flushing 55, N. Y.

WANTED — Tape recorder, 3¾ ips or dual speed. Pay cash or have 3" scope, multimeter, 17" TV, tubes, parts to swap. H. J. Ferguson, 4713 Court M, Birmingham 8, Ala.

WANT — Test equip. or other TV and radio parts, for Remington elec. shaver and fishing equip. Ernest A. Sawyer, Box 346, Marshall, N. C.

SWAP — Hickok 156 traceometer, l. n., complete with cables and instruction manual for BC-221 or LM freq. meter. C. W. King, R. 1, Box 98-H, Clayman Rd., Sandston, Va.

FLYBACK TRANSFORMER & YOKE CHECKER

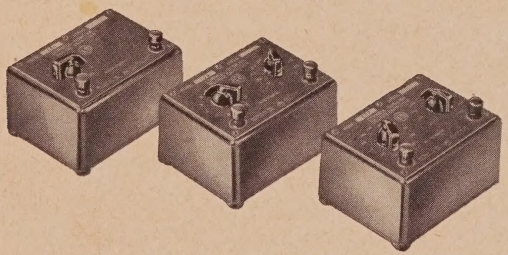
MODEL BF-80

The Cornell-Dubilier Flyback Transformer and Yoke Checker provides the television serviceman with a rapid and convenient means of locating defects in flyback transformers and yokes. This instrument is extremely sensitive and will immediately detect a single short circuited turn in the windings of either a flyback transformer or yoke. Without the use of such an instrument as the Cornell-Dubilier Flyback Transformer and Yoke Checker, it is most difficult to detect such a defect. Resistance measurements are not effective because a short circuited turn causes only a minute change in resistance and usually the resistance of a good transformer or yoke is unknown and subject to a wide tolerance. A short circuited turn on the other hand, causes a major change in inductance, which this instrument quickly detects.

In addition to detecting short circuited turns in magnetic windings, this instrument is designed to also provide a means for quickly detecting OPEN CIRCUITED conditions in transformers, yokes, coil and switches, or short circuited elements in vacuum tubes.

MODEL BF-80 CHECKER
NET PRICE complete with tube **$46.45**

CAPACITOR DECADES



CORNELL-DUBILIER CAPACITOR DECADES provide a reliable and accurate source of measured capacitances for substitution purposes in a wide variety of electronic applications within the voltage and capacitance ratings of each unit.
Units of capacitance can be selected from the direct reading switch scale markings and the precise value may be read directly from the hand calibrated chart provided with each instrument.

CORNELL-DUBILIER CAPACITOR DECADES may be grouped in parallel to provide a wide range of accurate standards with maximum flexibility. For example, one each of decades CDA, CDB and CDC in parallel will permit a selection of capacitances from 0 to 11.111 mfds., in steps of .0001 mfd.
Five C-D Decade models are available with ratings and tolerances as shown below:

Rated Voltage - 600 D.C. - 220 A.C.

Model	Capacity	+ or − Tol.	Dielectric	Net Price
CDA-5	.011 mfd. in .0001 mfd. steps	5%	Mica	$11.35
CDB-5	1.1 mfd. in .01 mfd. steps	5%	Oil-Paper	11.35
CDB-3	1.1 mfd. in .01 mfd. steps	3%	Oil-Paper	13.50
CDC-5	10.0 mfd. in 1.0 mfd. steps	5%	Oil-Paper	19.95
CDC-3	10.0 mfd. in 1.0 mfd. steps	3%	Oil-Paper	22.00

Cornell-Dubilier
DECADE RESISTORS

MODELS RDA-RDB-RDC

1 OHM TO 1,111,110 OHMS
IN STEPS OF 1 OHM

C-D Decade Resistors provide a reliable source of resistance for substitution purposes in a wide variety of electronic and electrical applications within the current and resistance rating of each unit. Units of resistance are selected from the direct reading panel switch scale.

Each instrument permits a possible selection of 110 resistance values.

RDA ..... $12.15 RDB ..... $12.50 RDC $12.50

USER'S NET PRICES

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